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ABSTRACT

Computers may change teachers' lifestyles, teaching styles, and perhaps even their personal values. A brief survey of the history of computers demonstrates the incredible pace at which computer technology is moving ahead. The cost and size of microchips will continue to decline dramatically over the next 20 years, while the capability and variety of use will continue to grow unabated. There are three basic challenges for teachers with regard to computers. First, they must learn as much as possible in this new and growing field. Second, they must open the way for students to effectively learn to utilize this technology, and finally, they must teach students to use microcomputers wisely. Computer uses in education can be categorized as computer assisted instruction, computer literacy, or computer science. In using the computer, difficulties to overcome include providing sufficient hardware, appropriate software and adequate teacher training; changes in the curriculum; and the need for supportive school trustees and administrators. As changes occur, greater attention will have to be given to social and personal values. Predictions concerning the future are difficult to make; however, the potential influences and implications of the new technologies and computers in society do raise a series of difficult questions. (LMM)

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THE CHALLENGE of COMPUTERS

THERE IS NO TECHNOLOGICAL MIRACLE IN EDUCATION. NEITHER THE TELEVISION CAMERA, NOR THE COMPUTER, NOR PROGRAMMED LEARNING CAN PROVIDE "INSTANT" EDUCATION. EDUCATIONAL TECHNOLOGY IS NOT A BAG OF MECHANICAL TRICKS, BUT THE ORGANIZED DESIGN AND IMPLEMENTATION OF LEARNING SYSTEMS, TAKING ADVANTAGE OF, BUT NOT EXPECTING MIRACLES FROM, MODERN COMMUNICATIONS METHODS, VISUAL AIDS, CLASSROOM ORGANIZATION AND TEACHING METHODS.

J. R. Grass
Director
Centre for Educational Research and Innovation
1971

MICROCOMPUTERS ARE DESTINED TO BE RANKED ALONGSIDE AUTOMOBILES AND TELEVISION SETS AS AMONG THE MOST SIGNIFICANT INVENTIONS OF THE TWENTIETH CENTURY.

Adam Osborne
AN INTRODUCTION TO MICROCOMPUTERS
VOLUME 0 - THE BEGINNERS BOOK
Third Edition - 1982

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TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

The two statements above seem to be in direct contradiction to each other. But are they really. What Mr. Grass is saying is that like many other technological innovations in education computers will not be the "salvation" or the "magic elixir" which will right all wrongs and create the ideal learning environment.

Adam Osborne on the other hand is saying that computers will have a profound influence on our lives. Just as profound an influence as television and automobiles. I do not have to describe to you the changes in lifestyle and values that these two inventions have brought to our lives.

I am here today to talk to you about computers and how I believe they will change your lifestyle, teaching style, and perhaps even your personal values.

I plan to do this by first looking at a brief history of the field of computers to help you realize the speed at which this technology is moving.

In the second and third areas I will discuss the challenges to the classroom teacher in utilizing this technology and coping with the changes in values which will come about because of it.

In the fourth part of my talk I will try to gaze into my crystal ball and try to predict what may happen in the future. I realize this is fraught with danger.

HISTORY

As mentioned earlier computer technology is moving ahead at an incredible pace. Lets take a quick look at the modern history of computers.

The ENIAC (Electronic Numerical Integrator And Calculator) was the first electronic computer built in North America. It filled a room about the size of a classroom, weighed 30 tons, had 19,000 vacuum tubes (one blew every 7.5 minutes on the average), it used enough power to supply a small town, and cost $100,000.

It worked at the amazing speed of 5,000 calculations per second. Its primary use, by the way, was to calculate ballistic tables for the U.S. military. It was extremely good at this and could churn out 300 man (person) years worth in a day, when it was working.

In 1949 the transistor was invented but did not replace vacuum tubes immediately. The transistors used far less power than the vacuum tubes they replaced, and were much more reliable. We have come to promote their reliability by calling products made with them "solid state". Transistorized computers became prevalent in the late '60s. They were quickly replaced by a new technology.

In 1971 Intel brought out a new concept - the integrated circuit. This silicon "chip" one sixth of an inch long by one eighth of inch long crammed 2,250 "transistors" on it. Born was the beginning of the microcomputer.

The ability to double the number of transistorizied functions (tf) on a chip has progressed, on the average, every two years since then. Research indicates this will continue for the forseeable future. Chips are now being manufactered in three dimentional layers. IBM is now working on the production of 250,000 tf chips. Japan is concentrating its production on 64K chips, ie chips capable of remembering 64,000 characters. Keep in mind these chips are smaller than your little fingernail, use almost no power, and are extremely reliable.

In his book THE MICRO MILLENIUM Christopher Evans uses this analogy to highlight this pace. If the advances in automobile engineering had gone ahead as rapidly as computer technology then you would be able to buy a Rolls-Royce for $2.75, it would do three million miles to the gallon, and it would deliver enough power to drive the Queen Elizabeth II. And if you are interested in miniaturization, you could place half a dozen on a pinhead.

What is the point of all of this? The cost and size of these devices will continue to decline dramatically over the next 20 years. The capability and variety of use will continue to grow unabated.

A small personal aside. In 1960 my brother managed the IBM service bureau in Montreal. I would go in on week-ends to help him and earn some exta spending money by sorting cards. The computer used in that office was less powerful and much harder to operate than the Commodre PET's we have in many of our schools today. The comparative cost - the PET's are about 1/500 the cost in real dollars.

THE CHALLENGE for TEACHERS

There are basically three challenges for teachers in computers. First, they must learn as much as possible in this new and rapidly growing field. We must not fumble the ball as we have with television. Secondly, we must open the way for our students so that they may learn to utilize this technology effectively. We will have to accept very often that the student's knowledge is far greater than your own. The third challenge is to teach our students to use them wisely. I will deal with this later under the theme challenge of values.

There is a crisis coming in education if we are not able to retrain and educate teachers in the use of computers in the classroom. To do this, we must first know and set our overall goals. We must all clearly understand what we want to accomplish within our educational system, because this will determine how computers will be used. If we do not adequately define our goals, we may be trapped into a narrow and ill-conceived use of this innovation in teaching.

Well, why computers? What do they enable us to do that we couldn't do before? Computers are incredibly fast and accurate. Any inaccuracies are usually attributable to human input errors or poor system design and programming. You can also store and retrieve a large ammount of data in a small space and in a short span of time. (Show 5 1/4" floppy diskette.) So what? As we shall see this can prove to be of great benefit to both the

teacher and student.

Computer use in education can be broken down into three broad uses. Computer assisted instruction, computer literacy, and computer science. Or as Robert Taylor, editor of the book Computer in the School, says TUTOR, TOOL, or TUTEE.

Computer assisted instruction usually refers to drill-and-practice programs or programmed learning or instruction. Often it includes some sort of testing portion and ideally a reporting or tracking program to assist the teacher in determining the progress of Jack or Jill. This is one area where you must be very careful with the progams you use. Do they meet the objectives of the teaching programme? For example if it is a spelling program, are the words taught or drilled or tested out of context. Is it the best method available to you or, are you just using it to save yourself some marking? Most of what is around in this area is just an electronic rehash of the programmed learning texts of the fifties and sixties, and about as dull. Students are soon turned off and do you wonder why when they can be challenged and excited by the modern video arcade games. This is the use of the computer as the tutor and the student as the tutored. On the average it takes about 75,000 dollars of instructional design and programmming time to create one hour of good CAI.

Computer literacy involves the student in a deeper understanding of the tool. This is where the use of the computer becomes truly exciting. The industrial age gave man an extension to his muscle power. The computer for the first time gives man a true extension

of his mental capability. The microcomputer is now making it available to all people. It is bringing a new personalized power to the individual. Just as television made the world a global village, the microcomputer will give students the power to tap into the world's knowledge bank.

By using programs which turn the micro into a word processor, the drudgery writing, revising, and correcting will be removed. This should facilitate the work of the teacher, in that the student can easily be encouraged to turn in letter perfect assignments perfectly typed every time, and if they aren't perfect, know that it is no big deal to make the corrections and resubmit the work. Even at the primary level the children are thrilled to type their work into the computer, knowing that if they make a mistake they can go back and correct it easily. There is real joy when the printer churns out their story. One grade three class is printing their own school newspaper.

In the sciences the student can test a variety of factors, such as temperature, oxygen using pollutants, or the volume of the body of water, in a pollution simulation. As the factors are varied from trial to trial the effects of each factor on the environment are clearly demonstrated.

Students do not have to waste time graphing equations in mathematics. Once the basics of graphing is taught the student can use the computer to test a variety of equations to see the effects when variables and coefficients are changed. The computer can calculate and plot far faster than a student can by hand.

What is more important, that the student be able to plot equations or gain some insight into the graphed shapes of equations.

Students in our care must be computer literate if they are to enter the competitve work world.

Computer science students will a much greater level of understanding of the computer. I realize that not all students will have the zeal or the ability to seek this level of knowledge just as most of us do not have the desire, ability, or time to build and maintain our own cars. But many students do take readily to programming. There is a tremendous reward for the student when complete mastery of a system is accomplished. In one recent experience, a 19 year old student demontrated to an awestruck audience of teachers one of the best, if not the best, word processing programs written for the Commodore family of computers. It took him 10 months to write and rewrite, and rewrite, and rewrite..... . If you kwow anything about programming you will know that when you think all of the bugs are gone then another one creeps in. If we look at the true magnitude of that accomplishment, then how can we deny our students this opportunity.

To function as a tutor the computer must be programmed by some expert. This typically requires many hours of expert work to provide one hour of useful instruction. As humans, we are much more flexible than any machine. Creating a lesson to be delivered by a human requires less time, because it omits much of the detail and relies on the spontaneous improvisation and performance of the

teacher at the time of delivery. The teacher is flexible enough to respond to the needs of the learner during the lesson.

To function as a tool the computer need only to have a useful function progammed into it, such as word processing or a super calculating spread sheet like VISICALC. Many such tools have been created for business and industry. Few have been developed for education specifically.

When the computer is used as a "tutee", it is being tutored. What makes it a good "tutee"? It is dumb, it obeys your every command, it is patient, it is rigidly literal and if you don't like the results you can start all over from scratch. They don't talk back except to gently remind you when you have made an error. The ideal student?

There are difficulties to overcome. A few of these are:

a) sufficient hardware.
b) appropriate software.
c) adequate teacher training.
d) changes in the curriculum.
e) supportive school trustees and administrators.

The first two only take time and money. There must be sufficient hardware to allow teachers to "mess about". I cannot emphasize this too stongly. Teachers need time to come to grips with this technology but to do this, they must also have the tools at their disposal. The Ontario Ministr of Education, I believe, is approaching the issue of hardware from the wrong perspective.

They hope to impose a common technical standard on the rest of the industry or at the very least the Ontario market. Ontario is not a large enough market force, nor a strong enough leader in the technological sphere. There is also a danger in setting a technical standard too early in the life or development of a technology. (eg. television North American vs. European standards.) The one excellent project by the Ontario government, is the call for software development which went out last year. This should assist in providing **appropriate software.**

Teacher training will take time and money but it also takes a will and a determination on each individuals part to learn and succeed at this endeavour. There is also going to have to be some risk taking on the part of all concerned because there will be failures and there will be mistakes made.

The curriculum changes will be monumental because of this new power. We will have to decide what part of the curriculum is obsolete or should be radically altered, (eg. library skills), what part of the curriculum skills could be best delivered through CAI, and how we can compress our programmes to eliminate grade 13.

How do we win the financial support of adminstrators, trustees, government, and taxpayers in these troubled economic times?

THE CHALLENGE of VALUES

Alvin Toffler author of FUTURE SHOCK and now the THIRD WAVE calls the computer revolution the THIRD WAVE. The first wave was the move from the caves to an agrarian society. The second wave was the coming of the Industrial Revolution. The waves are coming at an ever increasing speed. This third wave will form the basis of what is termed the "information society". Now we can't live on information. We must eat real food, wear real clothes, and live in real houses. What is going to happen, is that less time and energy will be devoted to satisfying these needs and more time and energy will be spent on providing the information necessary to make decisions. Let me distinguish what I mean by information. There is a great deal of data accumulating in the world. It has been said that the entire knowledge of the world doubles enery five years. This knowledge only stops being data once it is organized, classified, stored and made retrievable to the rest of mankind. In the film GOODBYE GUTENBERG, the BBC film, this is strikingly shown, using the example of the CHEMICAL ABSTRACTS. The first abstracts took up only a few volumes at the turn of the century. Now the index to those volumes each year is larger than the original volumes but because the index is completely computerized, you can search through them in just seconds and find specifically what you are looking for. The "information society" needs an army of people to codify the data to turn it into useful information. This shift will have a profound effect on our lifestyles. It will affect our work, our leisure, and our family

life.

Historically, two facts emerge when we look at the effects of technology and society. The first is, that if a new wave is going to come, then it will come, regardless of the attempts a society may make to prevent it. The second is, that the military establishment usually has something to do with the acceptance, promotion, or development of that new wave. James Burke, in the book or film series by BBC, titled CONNECTIONS, has some excellent examples of these. Many of the technological developments cited changed the course of history. I will use two examples here.

Around 1725, an organ maker named Basile Bouchon, developed an automated loom. His idea was improved upon by Joseph Marie Jacquard and thereby threw thousands of weavers out of work. The weavers responded predictably by smashing the new looms. Where they were stong enough, the guilds were able to prevent the adoption of the new looms which threatened their livelihood. The story doesn't end there. In the new world there was a shortage of skilled workers but a great demand for the product of the loom - cloth. The Americas imported only the craftsmen, to build the looms and then used the untrained and unskilled farm girls to tend the looms. This allowed the American factories to be more competitive than the European factories which had developed the technology in the first place.

Moral -- The innovator of a technology rarely ends up being the leader in that technology.

Corollary -- The leader in a technological field rarely is the

leader in succeeding technologies.

The idea that the military spurred on the invention or development of a technology is not new. Napoleon knew that an army travelled on its stomach. One of the greatest impediments for him in conquering Europe was that he could not carry enough fresh food with the army and, understandably, the conquered did not want to share their bounty. He gave a prize to any one who could preserve food for the long trips his armies undertook. Born was the whole food canning industry.

A modern day example rests with the space race. The military superiority in space may mean superiority on earth. The Americans trailed the Russians badly in the ability to send up large payloads. To overcome this problem the microprocessor was developed to reduce size and weight. It was cheaper, faster and easier to miniaturize the components, than it was to develop bigger rockets.

So much for history. Lets look at work today and in the future. In her book WOMEN AND THE CHIP, Heather Menzies says:

> "CANADIAN WOMEN ARE ON A COLLISION COURSE BETWEEN THEIR CONTINUING CONCENTRATION IN CLERICAL OCCUPATIONS AND INDUSTRIES DIMINISHING REQUIREMENTS IN THAT LINE OF WORK."

In 1971 over 50% of the jobs held by women were in the clerical and service fields (less than 15% of males held this type of position) and the percentages were still rising. These are precisely the segments of our population which will be hit hardest by the silicon office as it is termed. Men are not immune to the effects of automation either. Forty percent of the male labour force is in production and service. With robots replacing production workers at an alarming rate, there will be a marked decrease in employment opportunities for the unskilled older worker who will be too hard or too expensive to retain.

There will be massive displacement of workers from the traditional job market. Employers will, when the opportunity arises, steamline their office and production operations. There will be less demand for goods and services. This can already be seen in the automotive industry where fewer cars are being produced and sold. Gone are the days when automobile manufacturing is our leading industry.

Gordon Rattray Taylor writes (p244 UNCERTAIN FUTURES) .....that social change disrupts the social machine..... . Technology is the ultimate author of these ills and especially too much technology, too fast.

These are the social issues.

Equity or Social Justice

Economic Efficiency

Personal Freedom

Stability or Order

These are the personal values which we will have to be concerned with.

Motivation / Apathy

Work Ethic

Integrity and Personal Honour

Reality / Escapist Orientation

Concern for Others

Concern for the Future

Optimistic / Pessimistic

What is the true measure of a person and his or her contribution to society?

THE CHALLENGE of THE FUTURE

There is a great deal of evidence that human institutions do not adjust very readily to small pressures. As pressures build, the institution reacts defensively, hardening its shell so to speak, to ward off external threats. Not until the pressures become overwhelming and some sort of crisis or revolution occurs is the institution swept away or reformed in a fundamental way. The human mind tends to work in water tight compartments.

The dynamics of change can be broken down into three categories, sociopolitical, demographic/economic, and scientific/technological. It is usually under one of these banners that one allies himself with when predicting the future. Forecasters of the future all labour under the same problem, they cannot accurately predict the turn of the three forces mentioned above. They usually predict more or less in the future depending on whether they are optimistic or pessimistic. I am sure if computers existed 100 years ago, one of the first predictions would have been that we would be up to our waist in horse manure by 1982.

What I would rather do, than try to predict the future, is to ask a series of questions. I know this is a cop-out but if you really want to go through this exercise than read Toffler's THIRD WAVE, or Chistopher Evans' THE MICRO MILLENIUM. They do a better job of it than I do anyway. Just bear in mind that when Toffler wrote FUTURE SHOCK in 1971 he did not even mention or predict the

influence or infiltration of microelectronics into our lives.

I will leave you with a series of questions. I do not believe there are easy answers to any of them.

How do we retrain those displaced workers, many who are unskilled and perhaps unretrainable?

How do we change our education system, so that we will prevent this in the future?

What do we do with those that are unretrainable?

Who decides who is to benefit from the new technologies?

How do we establish long term health and safety factors when there are so many unknowns?

How do we know that there is a hazzard and that it is not just displeasure with the job?

How do we know if a worker is unhappy just because there is a change?

What are the alternatives?

Is it all a big sales pitch by multinationals like IBM and Xerox?

How will it affect our leisure?

Is it truly progress or is it a new form of slavery?

How can the THIRD WORLD benefit or will they only be exploited?

Privacy

How do we maintain our privacy, knowing that our every move can be traced by our credit cards?

Could our medical records be used against us?

Is this the real 1984 version of George Orwell's fiction?

Is BIG BROTHER really a computer?

Who creates the checks and balances, before it's too late?

Are we already out of control?

What controls are necessary?

Is technology moving so fast that we can't regain control?